

[0053] The handheld electronic device 410 displays a representation of the scene 415 including a representation of the side wall 416, a representation of the back wall 417, a representation of the floor 418, and a representation of the table 419. In surveying the scene 405, the handheld electronic device 410 generates a map of the scene 405 including a number of plane hypotheses in a CGR coordinate system. Each of the plane hypotheses defines a planar region in the CGR coordinate system and can be specified in any of number of ways. For example, in various implementations, a plane hypothesis includes a plane equation or corresponding coefficients. In various implementations, a plane hypothesis includes an indication of the bounds of the plane, e.g., the extent of the plane in the CGR coordinate system. Each of the plane hypotheses corresponds to a planar surface of the scene 405, such as the side wall 406, the back wall 407, the floor 408, or the top of the table 409.

[0054] In various implementations, the handheld electronic device 410 generates a plane hypothesis based on a point cloud. FIG. 5 illustrates the handheld electronic device 410 displaying a plurality of points 420 of a point cloud overlaid on the representation of the scene 415.

[0055] In various implementations, the point cloud is based on an image of the scene including a plurality of pixels (e.g., a matrix of pixels) obtained by a scene camera. In various implementations, the point cloud includes a plurality of three-dimensional points in the CGR coordinate system. In various implementations, the CGR coordinate system is gravity-aligned such that one of the coordinates (e.g., the z-coordinate) extends opposite the direction of a gravity vector. The gravity vector may be obtained by an accelerometer of the handheld electronic device 410. Each point in the point cloud represents a point on a surface of the scene 405, such as a point on the side wall 406, the back wall 407, the floor 408, the top of the table 409, or the legs of the table 409. In various implementations, the point cloud is obtained using VIO (visual inertial odometry) and/or a depth sensor. In various implementations, the point cloud is based on the image of the scene and previous images of the scene 405 taken at different angles to provide stereoscopic imaging. In various implementations, a point in the point cloud is associated with metadata, such as a color, texture, reflectance, or transmittance of the point on the surface in the scene or a confidence in the position of the point on the surface in the scene 405 (e.g., an uncertainty).

[0056] In various implementations, the plurality of points 420 includes one or more unpaired points (or single points), such as the unpaired point 431. In various implementations, the plurality of points 420 includes one or more sets of paired points, such as the two paired points 432A-432B. The two paired points 432A-432B define a line and are the endpoints of the line.

[0057] The handheld electronic device 410 can employ a variety of methods to determine a plane hypothesis (or multiple plane hypotheses) from the point cloud. For example, in various implementations, RANSAC (random sample consensus) methods are used to generate a plane hypothesis based on the point cloud. In one RANSAC method, an iteration includes selecting three random points in the point cloud, determining a plane defined by the three random points, and determining the number of points in the point cloud within a preset distance (e.g., 1 cm) of the plane. That number of points forms a score (or confidence) for the plane and after a number of iterations, the plane with the

highest score is selected for generation of a plane hypothesis. With the points on that plane detected removed from the point cloud, the method can be repeated to detect another plane.

[0058] However, in various implementations, RANSAC methods applied to three-dimensional point clouds can be time-consuming and computationally expensive. Accordingly, in various implementations, horizontal and/or vertical planes in the scene 405 are detected as follows.

[0059] FIG. 6 is a flowchart representation of a method 600 of generating a horizontal plane hypothesis in accordance with some implementations. In various implementations, the method 600 is performed by a device with one or more processors, non-transitory memory, and a scene camera (e.g., the HMD 120 FIG. 3). In some implementations, the method 600 is performed by processing logic, including hardware, firmware, software, or a combination thereof. In some implementations, the method 600 is performed by a processor executing instructions (e.g., code) stored in a non-transitory computer-readable medium (e.g., a memory). Briefly, in some circumstances, the method 600 includes: obtaining a point cloud of a scene, generating a height histogram of the points in the point cloud, and generating a horizontal plane hypothesis based on the height histogram.

[0060] The method 600 begins, in block 602, with the device obtaining a point cloud of a scene including a plurality of points in a gravity-aligned coordinate system. The point cloud may be obtained using a depth sensor, VIO, other computer vision techniques, or the like. In various implementations, each of the plurality of points is associated with three coordinates in the gravity-aligned coordinate system, one of the three coordinates (e.g., a “z-coordinate” or a “height coordinate”) corresponding to a height of the point. In various implementations, each of the plurality of points is further associated with an uncertainty, e.g., an uncertainty (or, conversely, a confidence) in the position of the point on the surface in the scene. In various implementations, a point in the point cloud is associated with metadata, such as a color, texture, reflectance, or transmittance of the point on the surface in the scene.

[0061] In various implementations, the plurality of points includes one or more unpaired points. In various implementations, the plurality of points includes one or more sets of paired points. Each of the set of paired points defines a line having a length.

[0062] The method 600 continues, at block 604, with the device generating a height histogram indicative of a plurality of non-overlapping height ranges in the gravity-aligned coordinate system and a respective plurality of weights. In various implementations, each of the non-overlapping height ranges is defined a center height of the non-overlapping height range. In various implementations, a point is associated with one of the plurality of center heights when the height coordinate of the point lies within the non-overlapping height range. For example, a point having a height coordinate of 1.01 may be associated with a center height of “1” corresponding to a height range from 0.95-1.05.

[0063] FIG. 7 illustrates an example height histogram 700 based on the point cloud represented in FIG. 5. The height histogram 700 indicates that the point cloud includes a first height bin 701 associated with a first height range and a first weight, a second height bin 702 associated with a second height range and a second weight, a third height bin 703